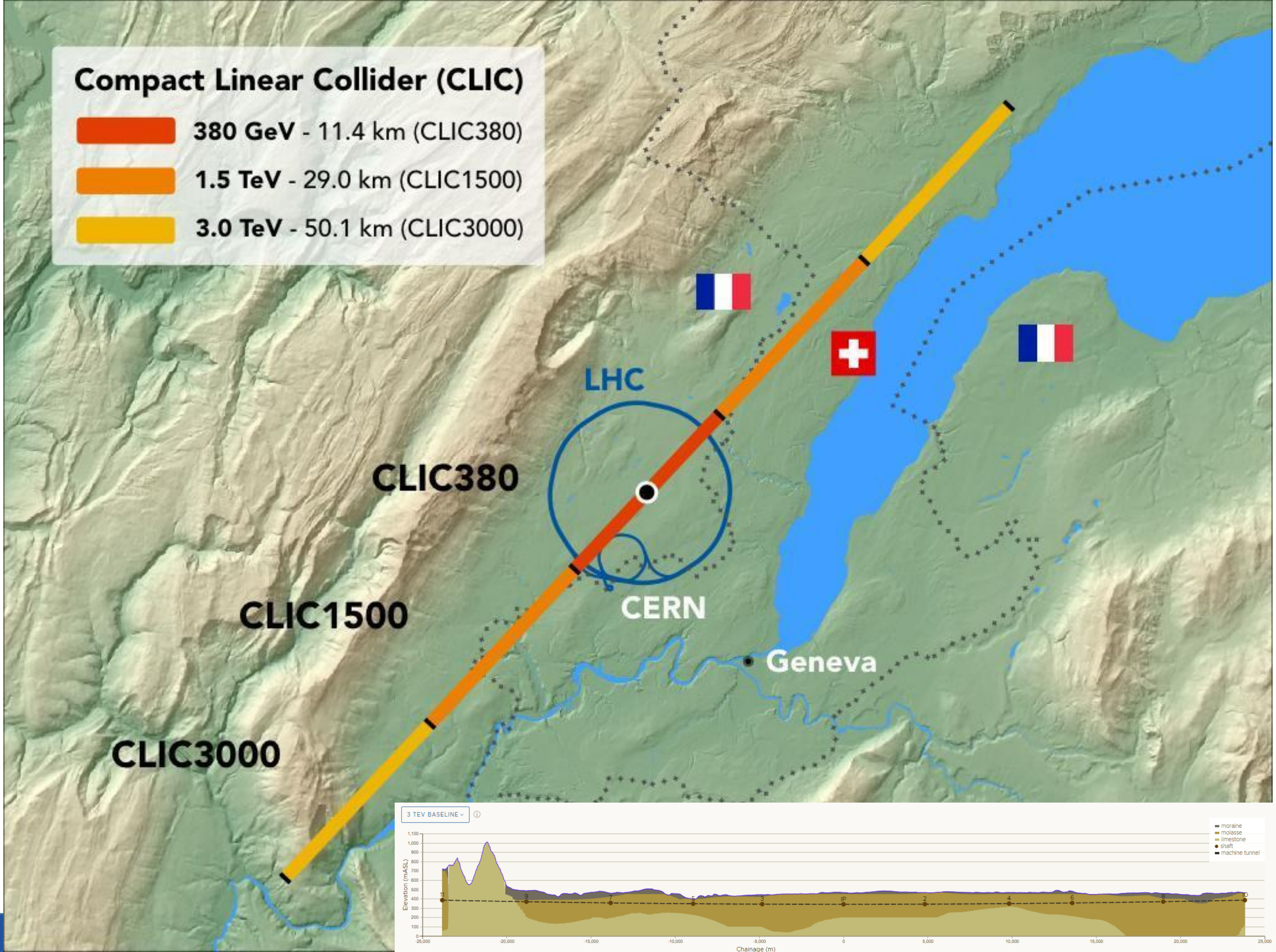
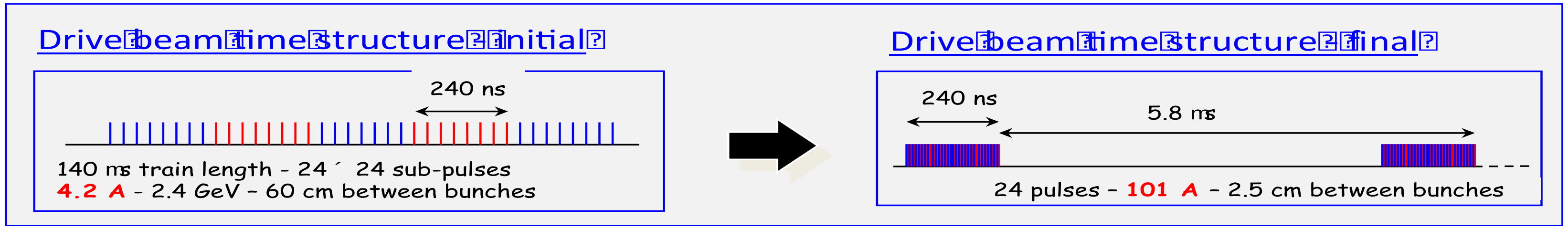
CLIC news

POSIPOL - CERN 2018

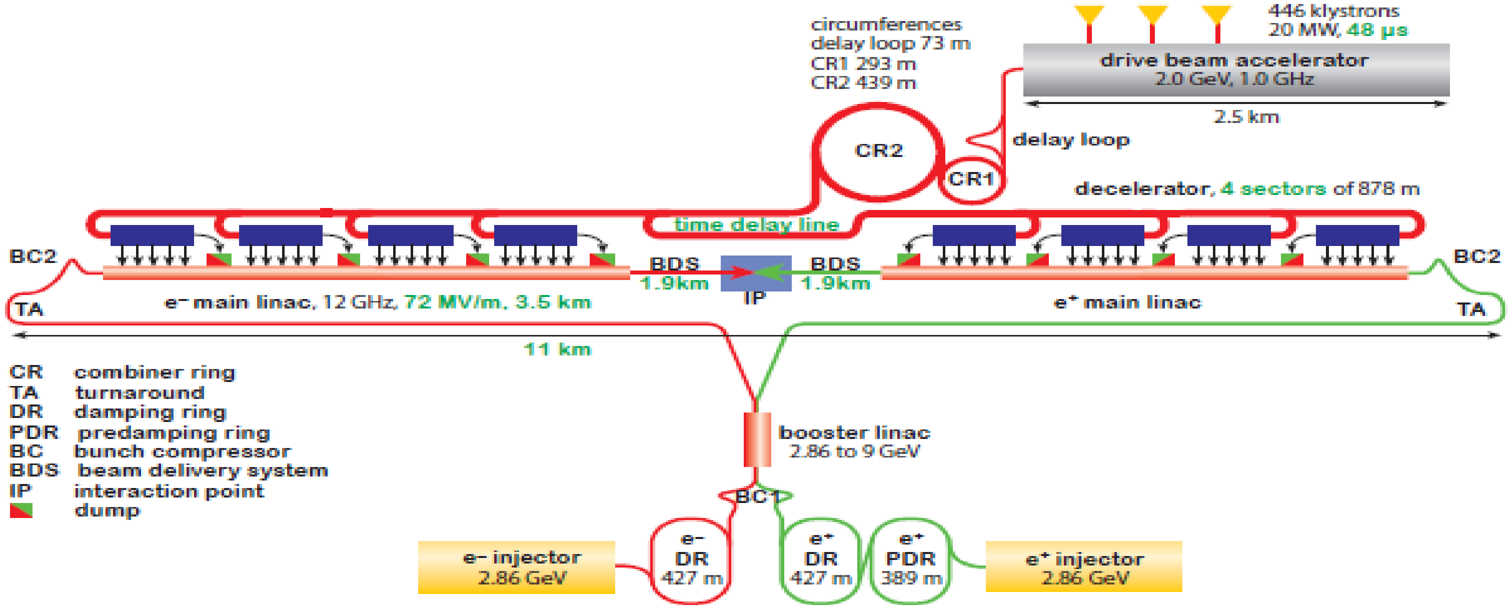
Steinar.Stapnes@CERN.CH
on behalf of the CLIC collaboration

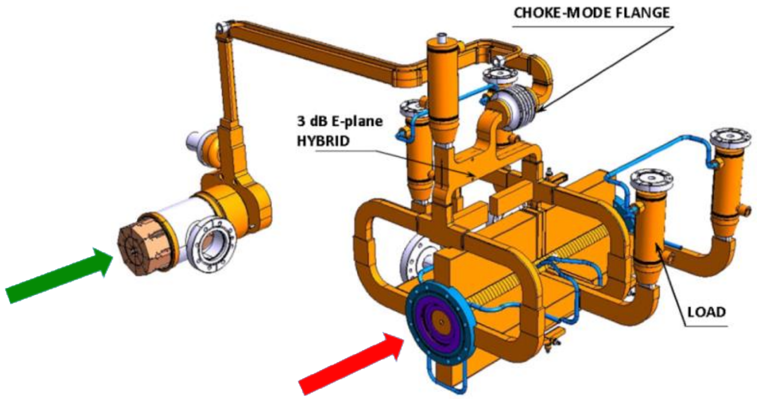

Compact Linear Collider (CLIC)
380 GeV - 11.4 km (CLIC380)
1.5 TeV - 29.0 km (CLIC1500)
3.0 TeV - 50.1 km (CLIC3000)
LHC
CLIC380
CLIC1500
CLIC3000
CERN
Geneva
3 TEV BASELINE
moraine
molasse
limestone
shaft
machine tunnel
Elevation (mASL)
Chainage (m)

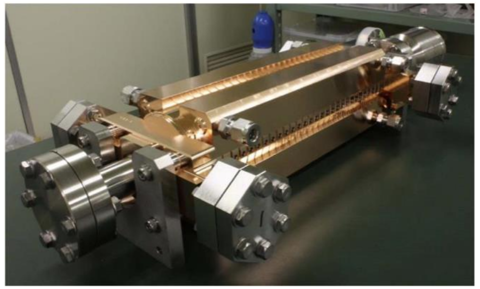
CLIC layout, power generation



Drive-beam (low energy, high intensity, long pulses) created by klystrons







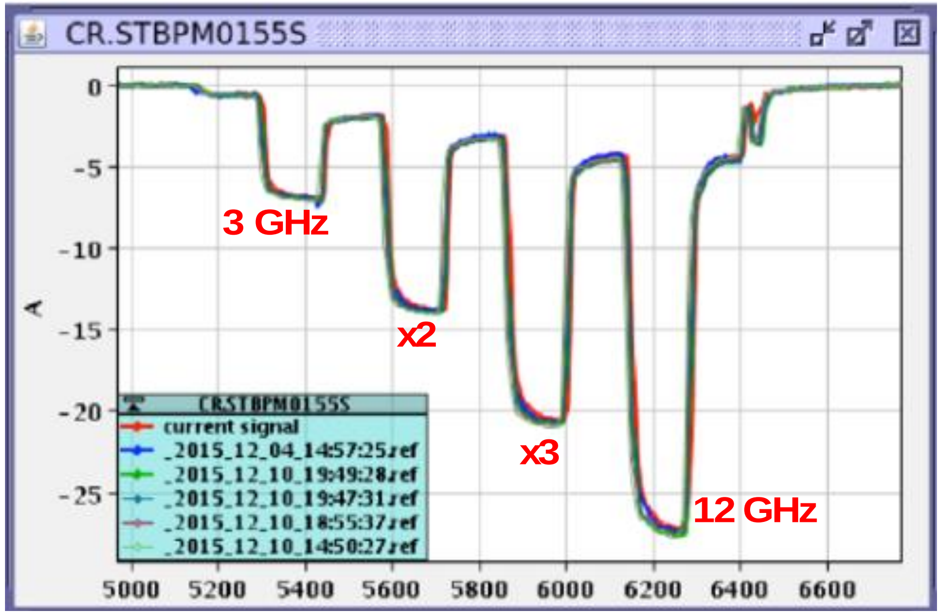
Also look at klystron driven version

Drive beam quality

- Produced high-current drive beam bunched at 12 GHz

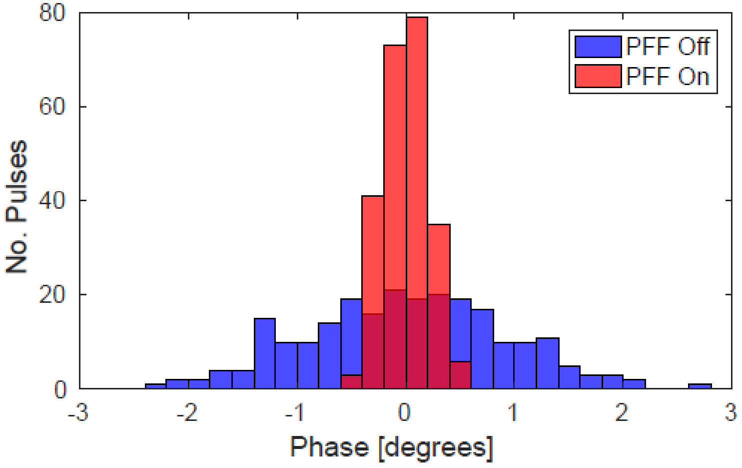
Three challenges:

- **High-current drive beam bunched at 12 GHz**
- Power transfer + main-beam acceleration
- ~100 MV/m gradient in main-beam cavities



28A

Arrival time stabilised to 50 fs

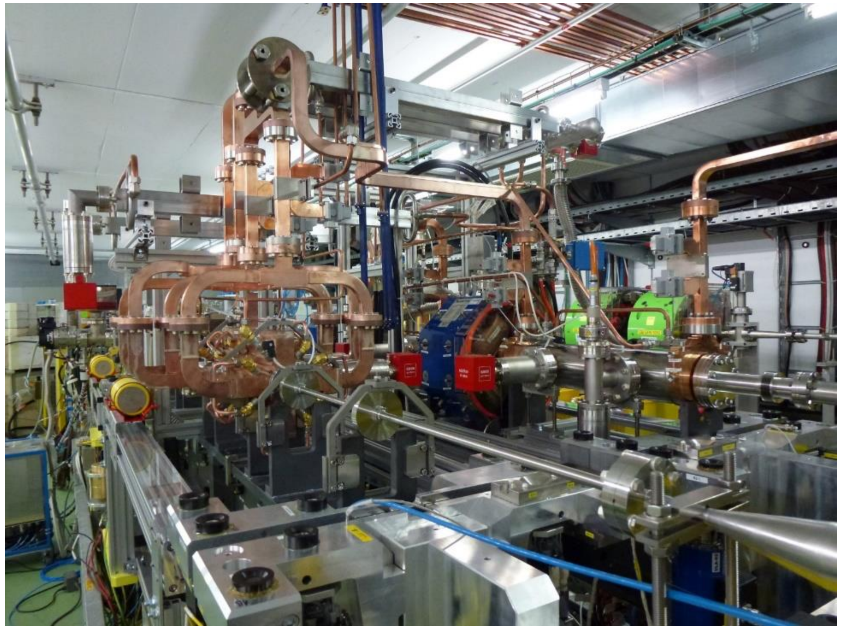


Two beam acceleration

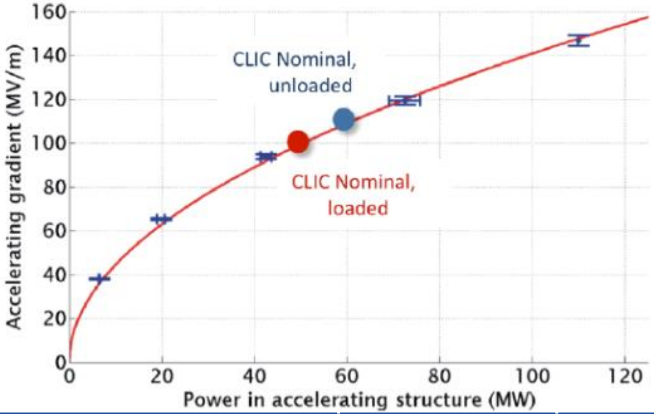
Three challenges:

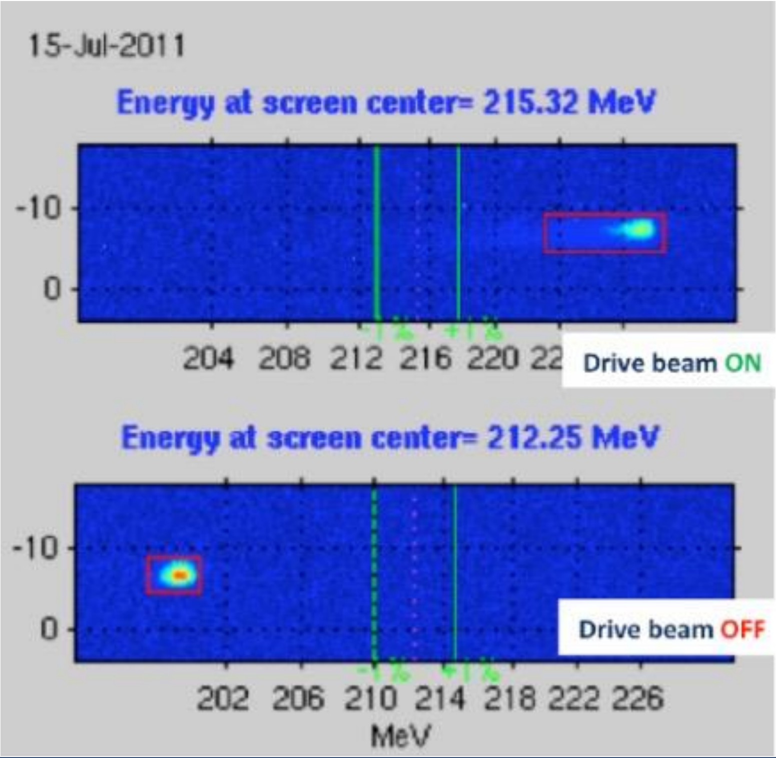
- High-current drive beam bunched at 12 GHz
- **Power transfer + main-beam acceleration**
- ~100 MV/m gradient in main-beam cavities

- **Demonstrated two-beam acceleration**



31 MeV = 145 MV/m



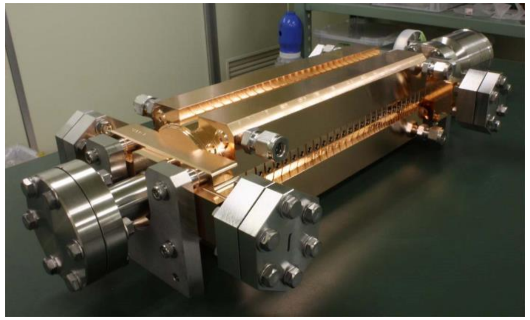


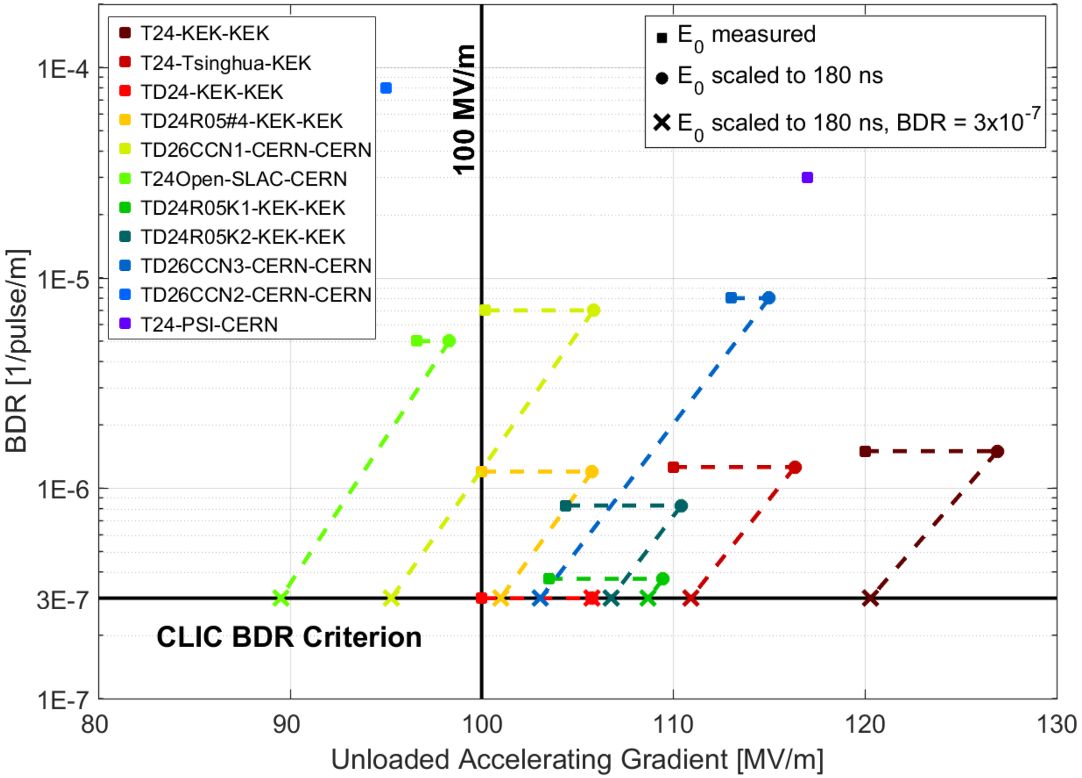
X-band performance

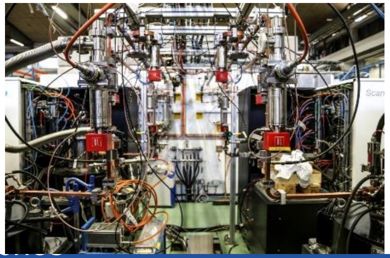
- Achieved 100 MV/m gradient in main-beam RF cavities

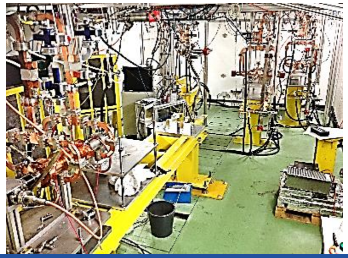
Three challenges:

- High-current drive beam bunched at 12 GHz
- Power transfer + main-beam acceleration
- **~100 MV/m gradient in main-beam cavities**





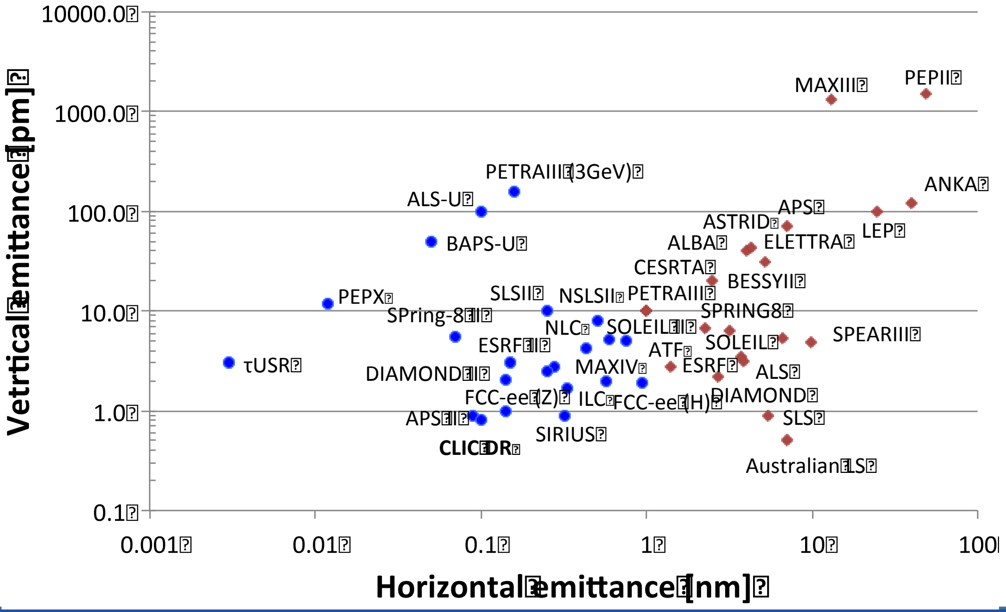


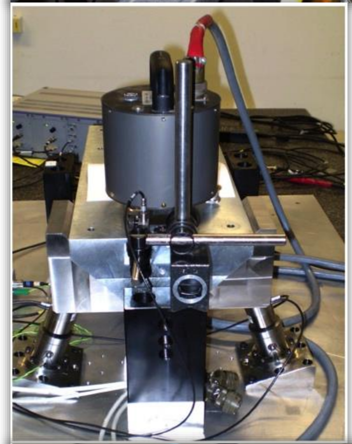


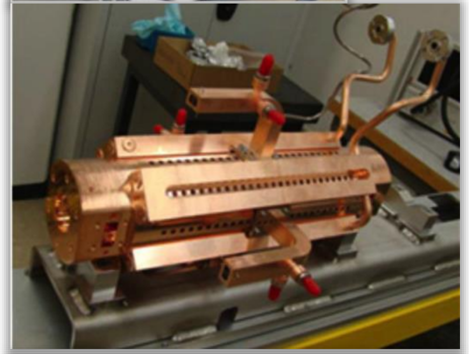
Nano-beams

The CLIC strategy:

- Align components (10µm over 200m)
- Control/damp vibrations (from ground to accelerator)
- Measure beams well – allow to steer beam and optimize positions
- Algorithms for measurements, beam and component optimization, feedbacks
- Tests in small accelerators of equipment and algorithms (FACET at Stanford, ATF2 at KEK, CTF3, Light-sources)

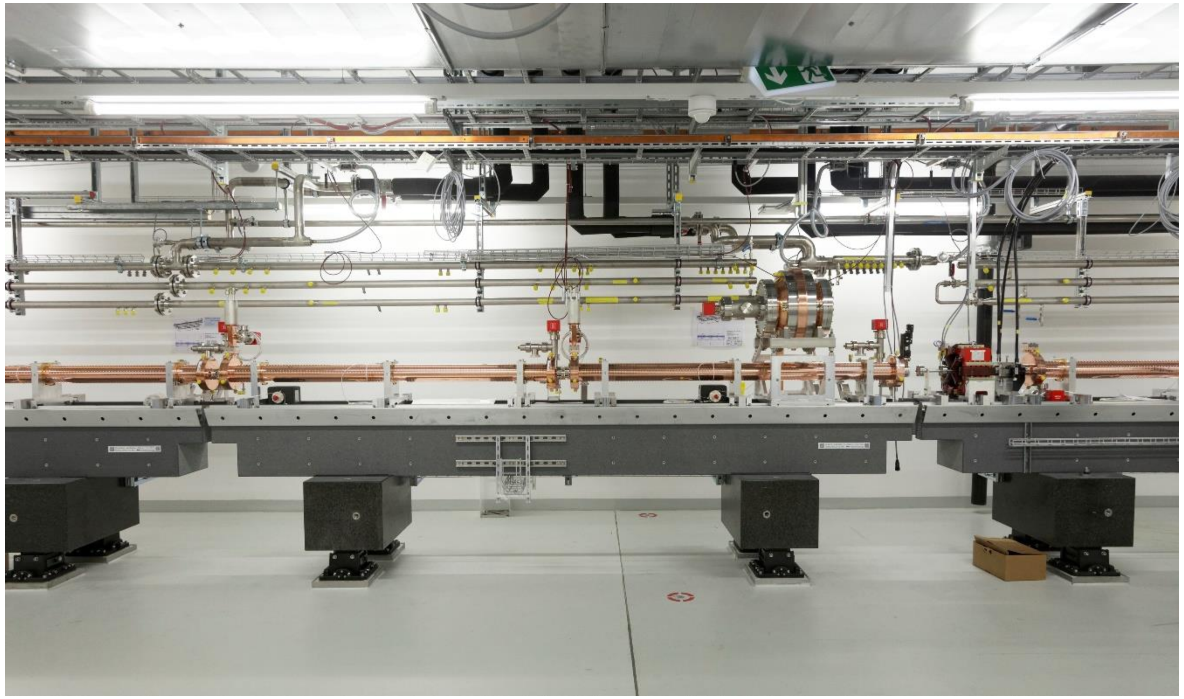






SwissFEL – C-band linac

- 104 x 2m-long C-band structures
  (beam → 6 GeV @ 100 Hz)
- Similar um-level tolerances
- Length ~ 800 CLIC structures
- Being commissioned

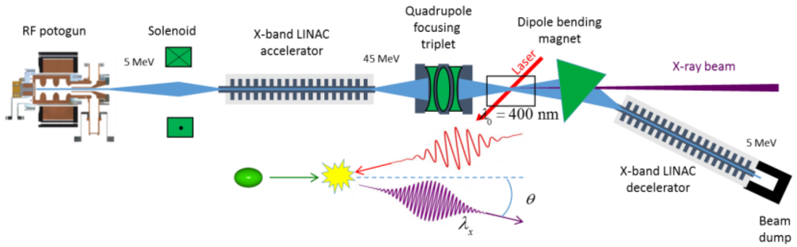


CLIC Technology and FELs

CLIC technology for different applications

- EU co-funded FEL design study
- SPARC at INFN-LNF
- … many other small systems ...

INFN Frascati advanced acceleration facility
EuPARXIA@SPARC_LAB

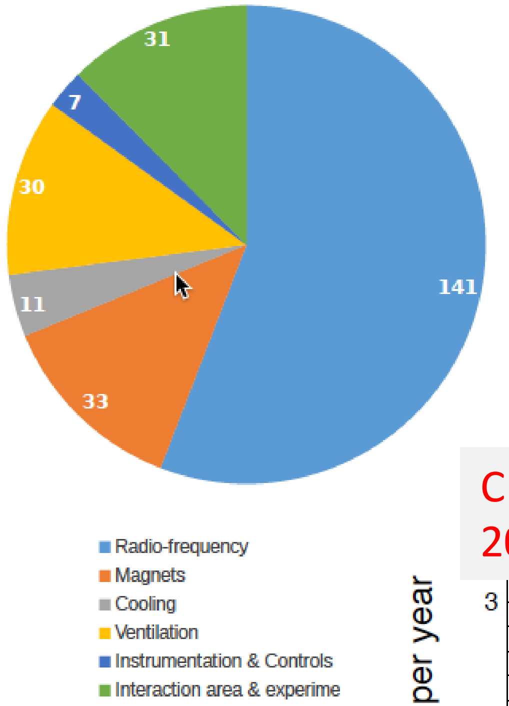


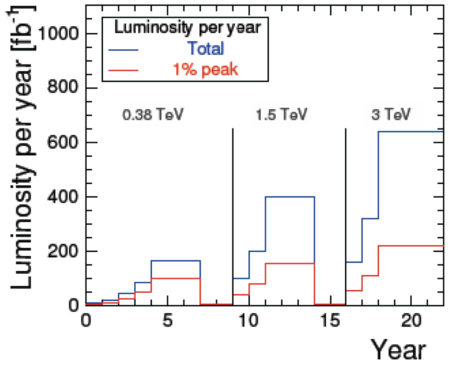
Eindhoven University led
SMART*LIGHT Compton Source

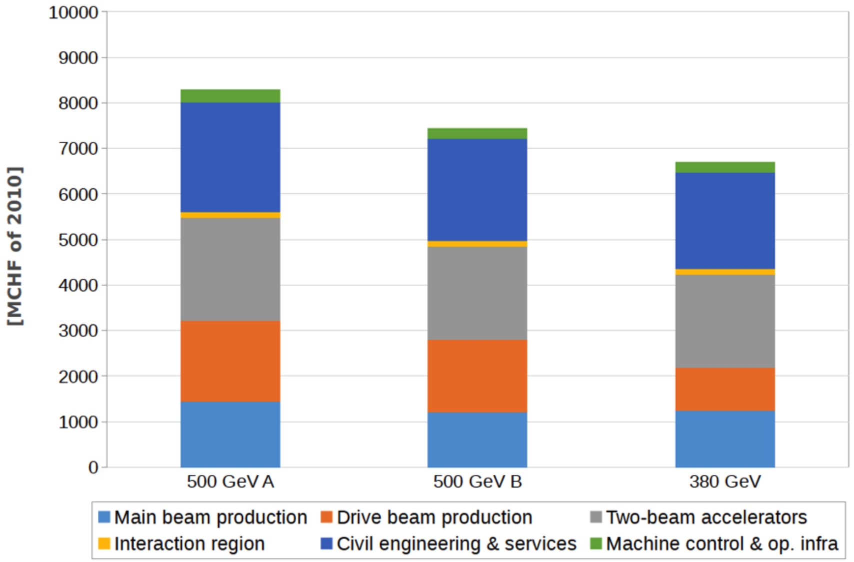
Cost and Power

Table 11: Value estimate of CLIC at 380 GeV centre-of-mass energy.

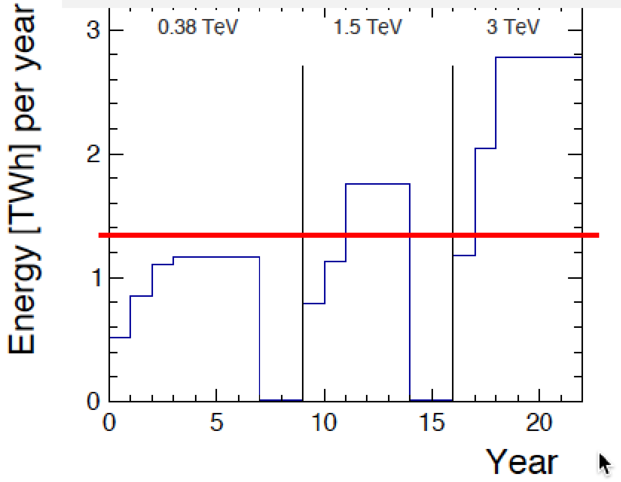
	Value [MCHF of December 2010]
Main beam production	1245
Drive beam production	974
Two-beam accelerators	2038
Interaction region	132
Civil engineering & services	2112
Accelerator control & operational infrastructure	216
Total	6690







CERN energy consumption
2012: 1.35 TWh



A cost of ~6 BCHF and power ~200 MW are considered “reasonable” values → implementable

2013 - 2019 Development Phase

Development of a Project Plan for a staged CLIC implementation in line with LHC results; technical developments with industry, performance studies for accelerator parts and systems, detector technology demonstrators

2020 - 2025 Preparation Phase

Finalisation of implementation parameters, preparation for industrial procurement, Drive Beam Facility and other system verifications, Technical Proposal of the experiment, site authorisation

2026 - 2034 Construction Phase

Construction of the first CLIC accelerator stage compatible with implementation of further stages; construction of the experiment; hardware commissioning

2019 - 2020 Decisions

Update of the European Strategy for Particle Physics; decision towards a next CERN project at the energy frontier (e.g. CLIC, FCC)

2025 Construction Start

Ready for construction; start of excavations

2035 First Beams

Getting ready for data taking by the time the LHC programme reaches completion

While being strategized

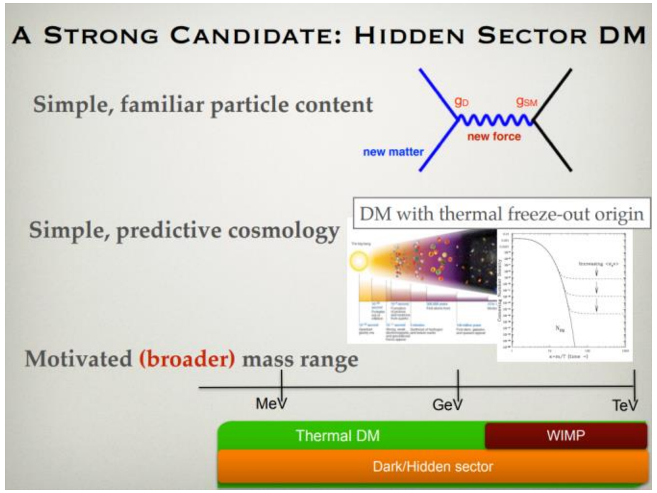
Look at common areas in all scenarios – consider key topics or facilities 2019-2023

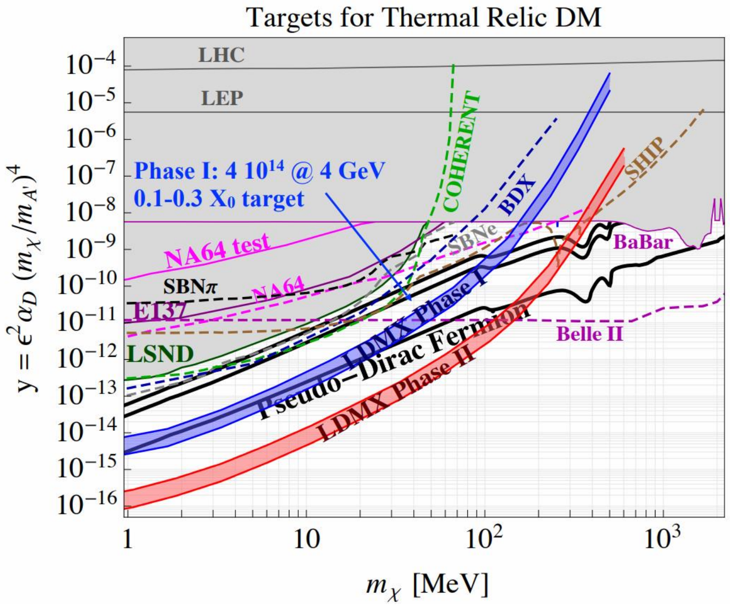
Cover all existing **existing** agreements with (INFN, UK, Spain, etc) that go into 2020, it also covers CompactLight obligations, ARIES transnational access, LCC

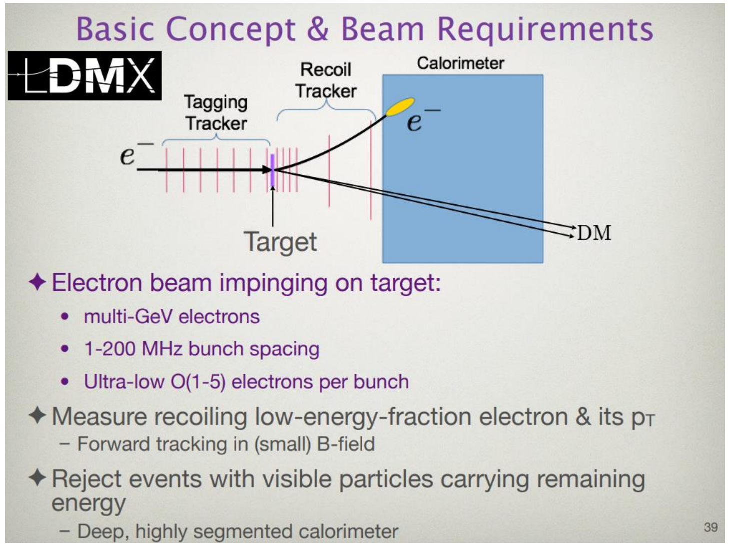
Also consider the key developments needed for eSPS (see next slide)

Wait and see budget 2019-2023
LC design team
Nano-beams and related system tests ATF, DR, etc
CLEAR
High Eff Klystrons/modulator and test-areas, module
Xbox operation and test-structures
Gun and positron studies (AWAKE, CLEAR, Compact Light, eSPS)

Physics with e-beams, LDMX







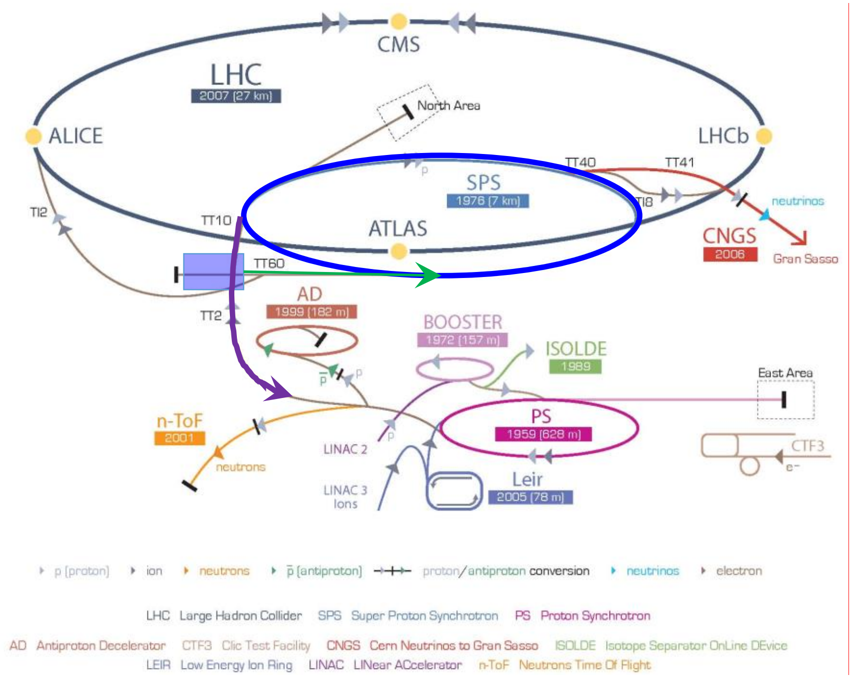
[1]Talk by P. Schuster
Exploring Hidden Sector Physics with an electron beam facility
Physics beyond collider annual workshop
November 21 2017, CERN
indico.cern.ch/event/644287/contributions/2762531/

[2] See more about the physics and project in recent talk: T. Åkesson https://indico.lal.in2p3.fr/event/4884/

Electrons at CERN - overview

Accelerator implementation at CERN of LDMX type of beam

- X-band based 70m LINAC to ~3.5 GeV in TT4-5
- Fill the SPS in 1-2s (bunches 5ns apart) via TT60
- Accelerate to ~16 GeV in the SPS
- Slow extraction to experiment in 10s as part of the SPS super-cycle
- Experiment(s) considered by bringing beam back on Meyrin site using TT10



Beyond LDMX type of beam, other physics experiments considered (for example heavy photon searches)

Acc. R&D interests: Overlaps with CLIC next phase (klystron based), FEL linac modules, e-beams for plasma, medical/irradiation/detector-tests/training, impedance measurements, instrumentation. positrons and damping ring R&D

European Strategy documents

- Official CLIC submissions:
  - CLIC project (accelerator + detector)
  - CLIC physics

- Supporting documents with accelerator contributions (allowed to be long):
  - CLIC Project implementation Plan ‘PiP’ (yellow report):
    - Accelerator parameters, cost, power, site, staging, construction schedule, summary of main technical issues, preparation phase summary
  - CLIC preparation-phase (2020-2025) plan (note):
    - Critical parameters, status and next steps - what is needed before project construction, strategy, risks + mitigation
  - CLIC 2018 summary report (yellow report):
    - Accelerator, detector, physics

- Additional supporting documents with detector/physics contributions:
  - CLIC physics potential (yellow report)
  - Detector technologies for CLIC (yellow report)
  - A detector for CLIC: main parameters and performance (note)

Key papers already out:

- Higgs Physics at the CLIC Electron-Positron Linear Collider (arXiv:1608.07538, Eur. Phys. J. C77 (2017) no.7, 475)
- Top-Quark Physics at the CLIC Electron-Positron Linear Collider *(https://arxiv.org/abs/1807.02441)*